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New species and new records of Panorpidae (Mecoptera, Panorpoidea) from southwestern China

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Abstract: The Panorpidae is the most species-rich family in extant Mecoptera, mostly distributed in the Northern Hemisphere. This paper reports the first record of the genus *Megapanorpa* Wang & Hua, 2019 from Guizhou and Yunnan Provinces, China, involving *M. jiangorum* Wang & Hua, 2019 and *M. yuebuqun* **sp. nov.** Furthermore, three new species of the genus *Neopanorpa* van der Weele, 1909 are described from Yunnan: *N. linghuchong* **sp. nov.**, *N. renwoxing* **sp. nov.**, and *N. yucanghai* **sp. nov.** In addition, we further discuss the geographical patterns and systematic positions of these taxa.

Keywords: Biodiversity, *Megapanorpa*, *Neopanorpa*, new records, new species, scorpionflies, taxonomy

中国西南蝎蛉科（长翅目，蝎蛉总科）新种、新记录种

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摘要：蝎蛉科 Panorpidae 是现生长翅目 Mecoptera 中物种最丰富的一个科，主要分布于北半球。本文首次报道广翅蝎蛉属 *Megapanorpa* Wang & Hua, 2019 在中国贵州和云南两省的分布新记录，包括姜氏广翅蝎蛉 *M. jiangorum* Wang & Hua, 2019 和岳不群广翅蝎蛉 *M. yuebuqun* **sp. nov.**。此外，描述 3 个分布于云南的新蝎蛉属 *Neopanorpa* van der Weele, 1909 新物种：令狐冲新蝎蛉 *N. linghuchong* **sp. nov.**、任我行新蝎蛉 *N. renwoxing* **sp. nov.**和余沧海新蝎蛉 *N. yucanghai* **sp. nov.**。本文亦针对这些分类单元的地理分布格局和系统位置进行讨论。

关键词：生物多样性，广翅蝎蛉属，新蝎蛉属，新记录，新种，蝎蛉，分类学

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Introduction

The Panorpidae is the most species-rich scorpionfly family in extant Mecoptera, and currently comprises two subfamilies and 13 genera (Bicha 2015; Wang & Hua 2019a, 2022; Willmann 2022, 2024). They are commonly called "scorpionflies" because the male genitalia are enlarged and recurved backward, resembling the stinger of a scorpion (Byers & Thornhill 1983; Dunford & Somma 2008; Byers 2009). Scorpionflies typically occupy moist forest habitats and are often found resting on the leaves of herbs or shrubs (Chou *et al.* 1981; Byers & Thornhill 1983; Wang & Hua 2016; Bicha *et al.* 2017). The adults are saprophagous, primarily feeding on dead arthropods and occasionally on other organic matter (Byers 2009; Palmer 2010). They are mostly distributed in the Northern Hemisphere, ranging from Europe through Asia and North America, and southward to the Indochinese Peninsula and the Indonesian Archipelago (Penny & Byers 1979; Bicha 2015, 2018).

The genus *Megapanorpa* Wang & Hua, 2019 (Panorpinae) was established from China (Wang & Hua 2019a). Members of this genus can be distinguished from other groups of Panorpidae, especially the single anal horn-bearing genus *Cerapanorpa* Gao, Ma & Hua, 2016, the *P. cornigera* group, and the *P. rufescens* group, by the following characters: A7 of male constricted and stalk-like at base; the female subgenital plate bearing a pair of laterotergites, and the medigynium (or genital plate) with a concealed axis. Six species are currently recognized: *M. absens* Wang & Hua, 2019 (Sichuan), *M. anfracta* (Ju & Zhou 2003) (Zhejiang), *M. gaokaii* Wang & Hua, 2019 (Hubei), *M. grandis* Wang & Hua, 2019 (type species, Shaanxi), *M. jiangorum* Wang & Hua, 2019 (Sichuan), and *M. wanghongjiani* Wang & Hua, 2019 (Gansu).

Neopanorpa van der Weele, 1909 (Neopanorpinae) is the second largest genus in the family, next to *Panorpa* Linnaeus, 1758 (Panorpinae), with approximately 170 species described to date (Wang & Hua 2019b, 2022; Xie & Wang 2025). Members of this genus are mostly endemic to the Oriental Region, being particularly abundant in southern China, the Indian subcontinent, the Indochinese Peninsula, and Indonesia (Rust & Byers 1976; Chau & Byers 1978; Penny & Byers 1979; Bicha 2018). Morphologically, *Neopanorpa* is characterized by the first anal vein (1A) ending proximal to the origin of radial sector (ORs), a single cross-vein between 1A and second anal vein (2A) in the forewings, a greatly developed notal organ and less developed salivary glands compared with those of *Panorpa* (Cheng 1957; Bicha 2015; Bicha *et al.* 2017; Wang & Hua 2017, 2018, 2020, 2021, 2022).

This paper reports the first record of the genus *Megapanorpa* from Guizhou and Yunnan Provinces, China, involving *M. jiangorum* and *M. yuebuqun* **sp. nov.** Furthermore, three new species of the genus *Neopanorpa* are described from Yunnan: *N. linghuchong* **sp. nov.**, *N. renwoxing* **sp. nov.**, and *N. yucanghai* **sp. nov.** The geographical patterns and systematic positions of these taxa are also discussed.

Material and methods

All the materials examined in this study are deposited in the Biological Science Museum, Dali University (BMDU). Adult insects were caught with collecting nets or malaise traps, preserved in 95% ethanol or pinned. Photographs were taken with a Nikon D850 digital camera in conjunction with a Nikkor AF-S Micro 105 mm f/2.8 lens (habitus), or a Canon R5 digital camera in conjunction with a Canon MP-E 65 mm f/2.8 1-5× macro lens or a Mitutoyo 10× M Plan Apochromatic Objective (the other images). The female habitus photos in dorsal view (Figs 1B, 3B, 5B, 7B & 9B) were modified to omit the left antenna, wings and legs. All pictures were adjusted and grouped with Adobe Photoshop CC. The terminology and measurements follow Wang & Hua (2019ab, 2021).

The following acronyms are applied in the main text:

1A = First anal vein (and so forth for other anal veins)

A1 = First abdominal segment (and so forth for other segments)

AbL = Abdomen length

AtL = Antenna length

BdL = Body length
FL = Forewing length
FW = Forewing width
HL = Hindwing length
HW = Hindwing width
ORs = Origin of Rs
T1 = First tergum (and so forth for other terga)

The following abbreviations and acronyms are used in figures:

Ae = Aedeagus
AH = Anal horn
Ap = Apodeme of axis
Ax = Axis
BL = Basal lobe
DBP = Dorsal branch of paramere
DBr = Dorsal bridge of paramere
DPr = Dorsal process
DV = Dorsal valve
Ep = Epandrium
EpL = Epandrial lobe
Gcx = Gonocoxites
Gs = Gonostylus
HpP = Hypandrial process
Hv = Hypovalve
LPr = Lateral process
Ltt = Laterotergite
Mg = Medigynium
MP = Main plate
MPr = Median process
NO = Notal organ
PA = Posterior arm
Pm = Paramere
PnO = Postnotal organ
SgP = Subgenital plate
StH = Stalk of hypandrium
StP = Stalk of paramere
VBP = Ventral branch of paramere
VV = Ventral valve

Taxonomy

Order Mecoptera Packard, 1886 长翅目
Superfamily Panorpoidea Latreille, 1802 蝎蛉总科
Family Panorpidae Latreille, 1802 蝎蛉科
Subfamily Panorpinae Latreille, 1802 蝎蛉亚科

Genus *Megapanorpa* Wang & Hua, 2019 广翅蝎蛉属

[New Record for Guizhou and Yunnan Provinces]

Diagnosis. This genus can be differentiated from other genera by the following features (Wang & Hua 2019a): 1) rostrum black frontally; 2) wings broad and long elliptical with reduced markings; in males, 3) T6 with a single anal horn, and A7 constricted stalk-like at base; 4) paramere U- or V-shaped subbasally, with a dorsal bridge connected to aedeagus, a slender ventral branch, and usually a dorsal branch; 5) aedeagus fused with gonocoxites and lacking distinct lateral processes; and in females, 6) subgenital plate with a pair of sclerotized laterotergites; and 7) medigynium flat, with axis entirely concealed in main plate.

Distribution. CHINA: Chongqing, Gansu, Guizhou, Shaanxi, Sichuan, Yunnan, Zhejiang (Wang & Hua 2022).

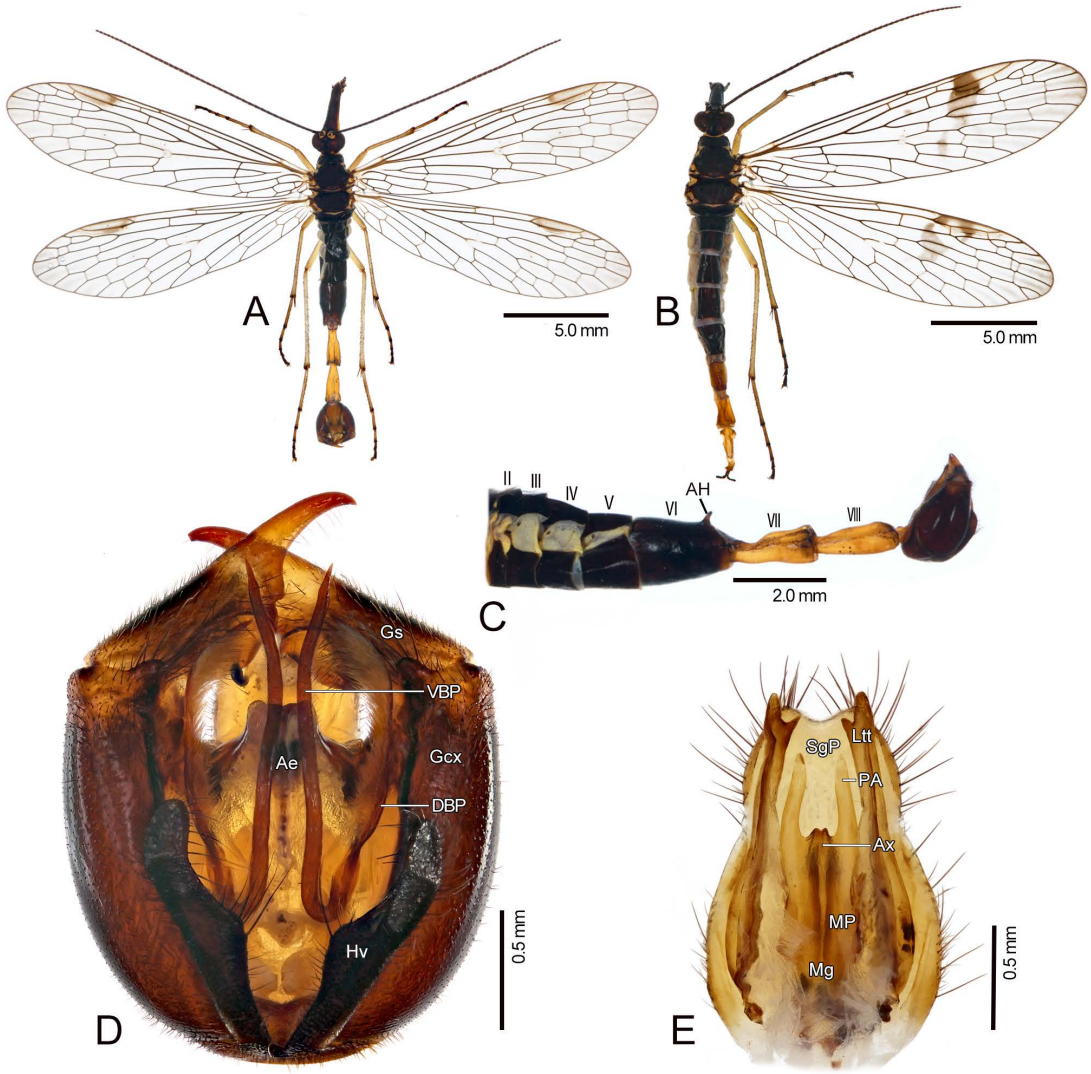

FIGURE 1. *Megapanorpa jiangorum* Wang & Hua, 2019: **A, C & D** male **B & E** female **A & B** habitus, dorsal view **C** abdomen, left-lateral view **D** genital bulb, ventral view **E** subgenital plate and medigynium, dorsal view.

Megapanorpa jiangorum Wang & Hua, 2019 姜氏广翅蝎蛉

[New record for Guizhou and Yunnan Provinces]

Wang & Hua, 2019a: 73, fig. 7 (type locality: China: Sichuan Province: Shimian)

Fig. 1

Specimens examined. CHINA: Guizhou Province: 2♀ (CN23Mejgr0012, 0013), Mt. Leigong, 26°22'59.73" N, 108°11'52.80" E, 1830 m, 10.vi.2023, leg. Dan-Chen Zhu; 1♂3♀ (CN23Mejgr0056–59), Mt. Fanjing, 27°54'10" N, 108°41'16" E, 2050 m, 5.vi.2023, leg. Dan-Chen Zhu; **Yunnan Province:** 2♀ (CN25Mejgr0030, 0031), Zhaotong City, Yiliang County, Xiaocaoba, 27°50'56.56" N, 104°17'58.41" E, 1950 m, 27.vi.2025, leg. Jiao Xie & Ji-Shen Wang.

Diagnosis. This species can be readily recognized by the following characters: 1) nota entirely black, mesal stripe absent; in males, 2) anal horn on T6 short and finger-like; 3) paramere exceeding apex of gonocoxites, with slender ventral branch much longer than dorsal branch, slightly curved laterally at distal portion; dorsal branch slightly curved in distal portion; in females, 4) laterotergites of subgenital plate bifurcated terminally, with inner branch short, outer branch longer and straight; and 5) medigynium with slender posterior arms.

Distribution. CHINA: Guizhou, Sichuan (Wang & Hua 2019a), and Yunnan Provinces.

Megapanorpa yuebuqun sp. nov. 岳不群广翅蝎蛉

https://zoobank.org/7EDE948E-D353-4200-80F4-2417ED508E92

Figs 2 & 3

Type material. CHINA: Guizhou Province: Holotype ♂ (CN23Meybq0001), Mt. Fanjing, 27°54'10" N, 108°41'16" E, 2050 m, 5.vi.2023, leg. Dan-Chen Zhu; paratypes 3♂2♀ (CN23Meybq0002–0006), same data; **Yunnan Province:** 1♂ (CN25Meybq0001), Zhaotong City, Yiliang County, Xiaocaoba, 27°50'56.56" N, 104°17'58.41" E, 1950 m, 27.vi.2025, leg. Jiao Xie & Ji-Shen Wang.

Etymology. The new species is named after Bu-Qun Yue, a prominent character in the classic wuxia novel *The Smiling, Proud Wanderer*, who outwardly presents himself as a virtuous and upright figure while secretly emasculating himself to achieve supreme martial arts and power. Noun in apposition.

FIGURE 2. Living male of *Megapanorpa yuebuqun* **sp. nov.**

Diagnosis. The new species closely resembles *M. absens* Wang & Hua, 2019 and *M. grandis* Wang & Hua, 2019 in the yellow and discontinuous notal stripe, but can be differentiated from the latter two by the following characters: in males, 1) notal organ on T3 short and small, slightly protruded posterodorsally (*vs.* stout, strongly protruded posterodorsally); 2) paramere bifurcated, two branches fused basally into a short and stout common basal stalk (*vs.* unbifurcated in *M. absens*, and bearing vestigial dorsal branch in *M. grandis*); and in females, 3) subgenital plate with narrow V-shaped emargination terminally (*vs.* shallow emargination in *M. absens* and wide in *M. grandis*).

Measurements (mm). *Male* (holotype and paratypes, n = 5): AtL 11.2–12.3, AbL 11.9–13.5, BdL 15.8–17.6, FL 15.0–15.4, FW 4.0–4.1, HL 13.7–14.1, HW 3.8–4.0; *female* (paratypes, n = 2): AtL 12.4–13.1, AbL 8.7–9.2, BdL 13.4–13.9, FL 16.9–17.0, FW 4.1–4.8, HL 14.6–14.9, HW 3.9–4.6.

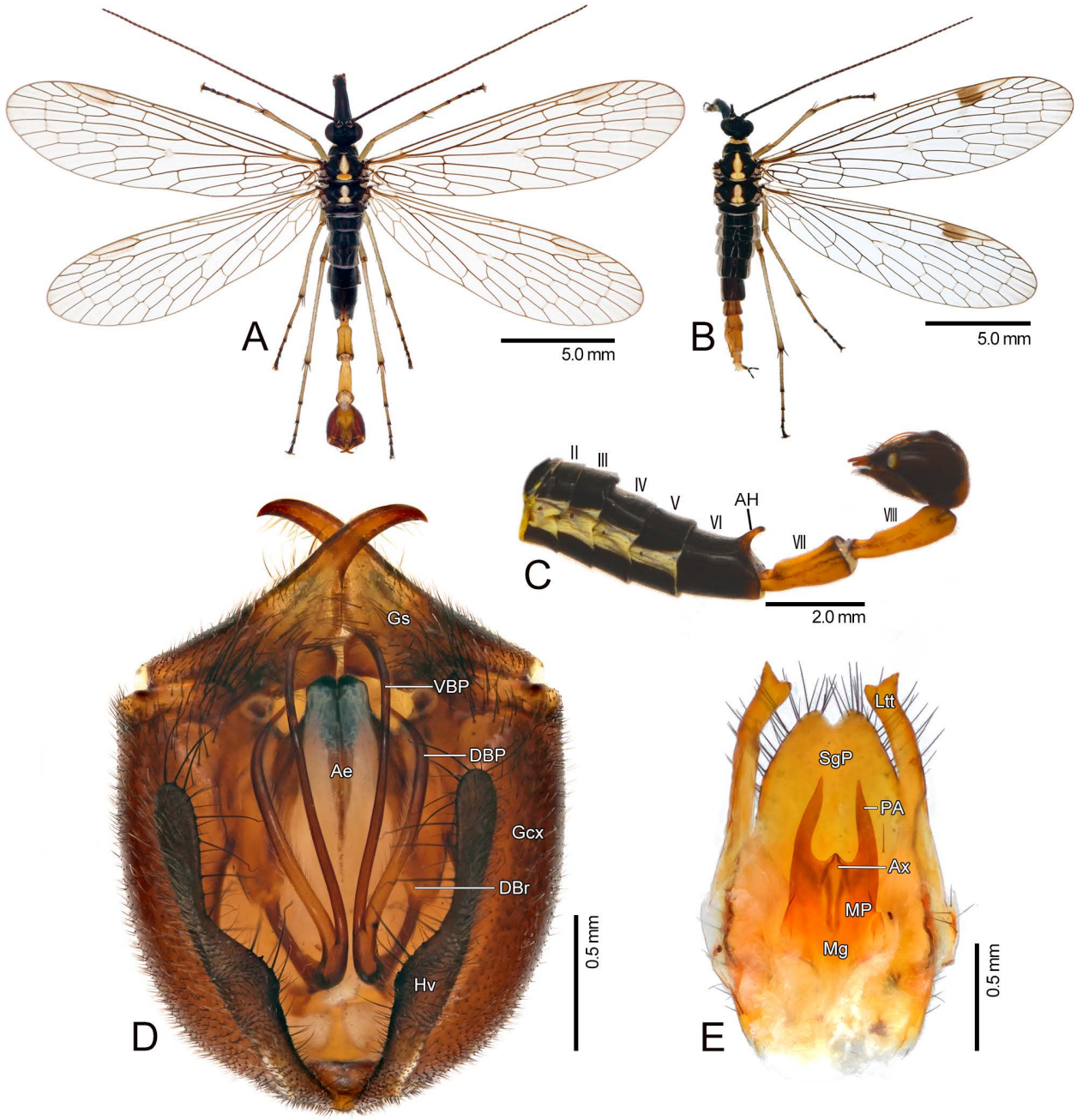

FIGURE 3. *Megapanorpa yuebuqun* **sp. nov.**: **A, C & D** male **B & E** female **A & B** habitus, dorsal view **C** abdomen, left-lateral view **D** genital bulb, ventral view **E** subgenital plate and medigynium, dorsal view.

Description. ***Male.*** *Head* (Fig. 3A). Vertex and ocellar triangle black. Rostrum mostly black. Antennae black.

Thorax (Fig. 3A). Pronotum black. Meso- and metanotum black, with yellow mesal stripe extending from anterior border of mesoscutum to metascutellum, and disconnected at mesopostnotum, forming two candle-flame-shaped patterns.

Wings (Fig. 3A). Wing membrane hyaline, without distinct markings; pterostigma light brown; apical margin slightly darkened; R_2 trifurcated.

Abdomen (Figs 3A & C). T1–T5 black. Notal organ on T3 short, slightly protruded posterodorsally, A6 mostly black, with only anal horn and ventro-apical border brown. Anal horn conical basally and finger-like apically. A7 greatly constricted and stalk-like in basal 1/4, with apex truncate; A8 slightly longer than A7.

Male genitalia (Fig. 3D). Male genital bulb spherical, reddish brown. Epandrium greatly emarginated in wide O-shape and forming pair of finger-like processes laterally. Hypandrium approximately 4/5 as long as gonocoxites, with extremely short basal stalk; hypovalves stripe-like, broadest and greatly projected in basal 2/5 of inner margin, paddle-like distally, and bearing several long, stout bristles along inner margin. Gonostyli shorter than gonocoxites, with blunt median tooth and short basal process. Paramere bifurcated with dorsal bridge strongly developed; ventral branch slender and glabrous, extending to middle of gonostyli, with tapering apex curved dorsomesally; dorsal branch slender, almost extending to apex of gonocoxites, bearing numerous microtrichia along inner margin, and slightly curved inward in distal portion; two branches fused basally into a short and stout common stalk. Aedeagus stout, with membranous and slightly divergent ventral valves, and blackish dorsal valves.

Description. ***Female.*** Similar to males in general appearance, except for greatly reduced pterostigma band (Fig. 3B).

Female genitalia (Fig. 3E). Female subgenital plate subtriangular, with narrow V-shaped emargination terminally. Laterotergites slender, exceeding apex of subgenital plate, and bifurcated terminally; inner branch blunt, outer branch longer and subacute. Medigynium with slender and slightly convergent posterior arms; apodemes of axis concealed; main plate with basal portion slightly expanded laterally.

Distribution. CHINA: Guizhou Province: Mounts Fanjing and Leigong; Yunnan Province: Zhaotong (Yiliang).

Subfamily Neopanorpinae Wang & Hua, 2021 新蝎蛉亚科

Genus *Neopanorpa* van der Weele, 1909 新蝎蛉属

Diagnosis. This genus can be differentiated from other genera by the following features (Wang & Hua 2020): 1) rostrum slender, with lateral margins nearly parallel; 2) compound eyes broad, as wide as or wider than middle part of rostrum in frontal view; 3) in forewings, 1A usually terminating before ORs; 4) with one cross-vein usually present between 1A and 2A, hindwing lacking cross-vein cu-a; in male: 5) T3 well-developed notal organ; 6) T4 with postnotal organ blunt or flattened; 7) paramere generally simple and slender; and in females: 8) main plate of medigynium usually undeveloped.

Distribution. Oriental Region.

Neopanorpa linghuchong sp. nov. 令狐冲新蝎蛉

https://zoobank.org/7226839A-D9E7-4A21-B53B-6AFDE02347B1

Figs 4 & 5

Type material. CHINA: Yunnan Province: Holotype ♂ (CN25Nlhc001), Zhaotong City, Yanjin County, 27°51'46.34" N, 104°16'45.28" E, 1400 m, 5.vi.2025, leg. Qing Tang, Liang-Jie Jia & Ji-Shen Wang; paratypes 6♂3♀ (CN25Nlhc002–010), same data.

Etymology. The new species is named after Chong Linghu, the main character in the classic wuxia novel *The Smiling, Proud Wanderer*, who, true to his free-spirited nature, rejects dogma and rigid conventions, living life on his own terms while excelling in martial arts. His maverick personality is also reflected in this species' distinctive characteristics among its congeners. Noun in apposition.

Diagnosis. The new species resembles those in the *N. tienmushana* group (Japan and southern China, *sensu* Wang & Hua 2021) in having a narrow black mesal stripe in meso- and metanotum, and yellow wings. However, the genital structure differs markedly. Its peculiar morphology recalls that of *N. choui* Cheng, 1949 in the greatly developed and aligned male paramere and the flat posterior arms in female medigynium. It differs from the latter in the following features: 1) vertex and occiput black (*vs.* with occiput yellowish brown); 2) in forewings, pterostigmal band with complete basal and apical branches, basal band complete (*vs.* with detached basal and apical branches; basal band split into one or two spots); in males, 3) T3 with notal organ extending to approximately 4/5 of T4 (*vs.* extremely elongated, extending beyond apex of A7); 4) hypandrium approximately 4/5 of gonocoxites (*vs.* beyond apex of gonocoxites, extending approximately basal lobe of gonostyli); 5) paramere unbifurcated, apically acute (*vs.* bifurcated, with apex split into two acute tips); and in females, 6) medigynium with axis very short; posterior arms broad and flat, with rounded apex (vs. medigynium with axis long; posterior arms slender, with acute apex).

Measurements (mm). *Male* (holotype and paratypes, n = 7): AtL 15.1–15.3, AbL 14.9–17.1, BdL 10.1–12.3, FL 14.6–15.1, FW 3.5–3.7, HL 12.7–13.3, HW 3.2–3.3; *female* (paratypes, n = 3): AtL 13.0–13.1, AbL 16.0–16.2, BdL 10.6–11.3, FL 14.4–15.8, FW 3.2–3.4, HL 12.2–13.1, HW 3.0–3.1.

Description. ***Male.*** Head (Fig. 5A). Vertex and frons yellowish brown, ocellar triangle enclosed by dark spots, occiput yellowish brown, with dark brown longitudinal stripe medially; rostrum yellowish brown; maxillae and labial palps dark brown. Antennae blackish.

FIGURE 4. Living male of *Neopanorpa linghuchong* **sp. nov.**

Thorax (Fig. 5A). Pronotum black and yellowish brown alternated. Meso- and metanotum light-brown laterally with narrow black mesal stripe. Pleura and legs pale brown with apex of tibia and distal tarsomeres black.

Wings (Fig. 5A). Wing membrane hyaline, tinged with yellow, markings brown. In forewings, apical band reduced to series of scattered spots. Pterostigmal band with complete basal and apical branches; marginal spot narrow; basal band complete, narrow anteriorly and broad posteriorly. Hindwing similar to forewings in shape and venation, with much more reduced markings.

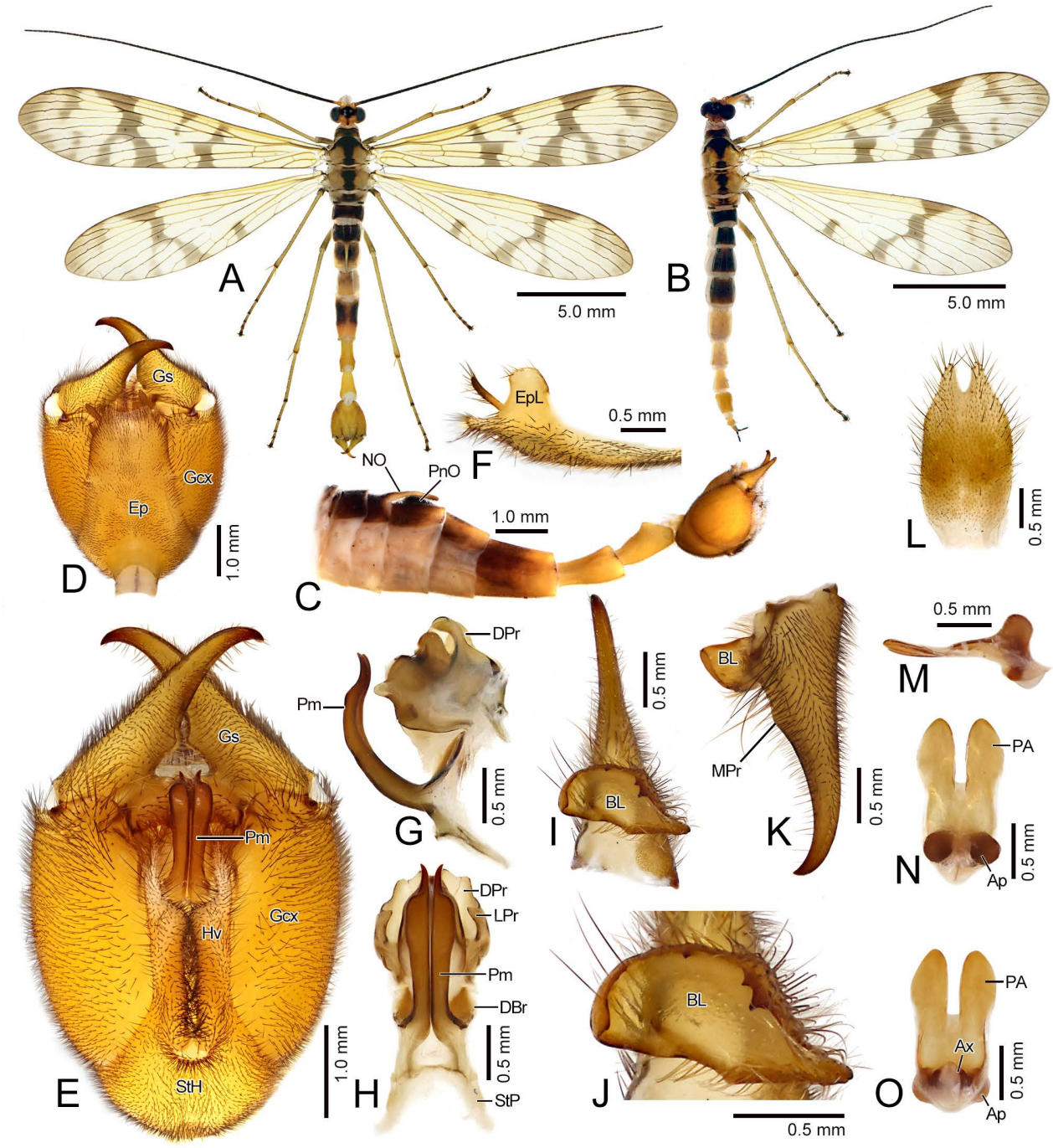

FIGURE 5. *Neopanorpa linghuchong* **sp. nov.**: **A, C–K** male **B, L–O** female **A & B** habitus, dorsal view **C** abdomen, left-lateral view **D** genital bulb, dorsal view **E** genital bulb, ventral view **F** epandrium, left-lateral view **G** aedeagal complex, right-lateral view **H** aedeagal complex, ventral view **I** right gonostylus, ventral view **J** basal lobe of right gonostylus, ventral view **K** right gonostylus, dorsal view **L** subgenital plate, ventral view **M** medigynium, right-lateral view **N** medigynium, dorsal view **O** medigynium, ventral view.

Abdomen (Figs 5A & C). T1–T2 black; T3 mostly black, with notal organ yellowish brown, arched dorsad, bearing dense microsetae along ventral surface, extending to approximately 4/5 of T4; T4 dark brown anteriorly and yellowish brown posteriorly, with tuft of short and cephalad-curling setae on dorso-mesal line; T5 unevenly yellowish brown. A6 dark brown anteriorly and yellowish brown posteriorly, about twice as long as A5, cylindrical, with apex nearly truncate. A7 and A8 yellowish brown and slightly constricted basally.

Male genitalia (Figs 5D–K). Genital bulb elliptical, yellowish brown. Epandrium broad, slightly emarginated terminally; epandrial lobes developed, subtrapezoidal, with apex rounded and broad. Hypandrium approximately 4/5 of gonocoxites, with basal stalk short and broad; hypovalves slender, relatively parallel, extremely narrowed in distal 1/3. Gonostyli slightly shorter than gonocoxites, with median tooth slightly raised, subtriangular; basal lobe prominent, elongate discoid, with three prominent tooth-like projections on caudal margin. Parameres rod-like in ventral view, hook-shaped in lateral view, closely aligned in stout basal 4/5 but divergent in abruptly slender and acute distal 1/5. Dorsal bridge sclerotized and broad. Lateral processes folded medially. Dorsal processes broad with margins curved.

Female. Similar to males in general appearance (Fig. 5B).

Female genitalia (Figs 5L–O). Subgenital plate broadly oval, with V-shaped terminal emargination (Fig. 5L). Medigynium flat in right-lateral view, with axis very short; apodemes dark brown, ellipsoid, and distinctly diverging; posterior arms broad and flat, with rounded apex.

Distribution. CHINA: Yunnan Province: Zhaotong (Yanjin).

Neopanorpa renwoxing sp. nov. 任我行新蝎蛉

https://zoobank.org/4CD392C4-D42D-44C2-96E7-3E0EDAFFD849

Figs 6 & 7

FIGURE 6. Living male of *Neopanorpa renwoxing* **sp. nov.**

Type material. CHINA: Yunnan Province: Holotype ♂ (CN23Nrwx001), Dali Bai Autonomous Prefecture, Yunlong County, Shuchang Village, 25°50'51.25" N, 99°15'21.39" E, 2470 m, 11.vii.2023, leg. Liang-Jie Jia, Jia-Ling Li, Chun-Mei Liao, Jiao Xie & Ji-Shen Wang; paratypes: 5♂2♀ (CN23Nrwx002–008), same data; 1♂7♀ (CN23Nrwx009–016), Dali Bai Autonomous Prefecture, Yunlong County, Forests near Zhuangdeng Village, 25°51'44.08" N, 99°39'14.89" E, 2300 m, 12.vii.2023, leg. Liang-Jie Jia, Chun-Mei Liao & Ji-Shen Wang; 1♀ (CN23Nrwx017), Diqing Tibetan Autonomous Prefecture, Weixi Lisu Autonomous County, Genggu, 27°32'17.18" N, 99°21'29.95" E, 2200 m, 10.viii.2023, leg. Chun-Mei Liao & Ji-Shen Wang; 1♀ (CN25Nrwx018), Kunming Prefecture, Motianling Mountain, 25°10'40.87" N, 102°44'50.78" E, 2060 m, 20.vii.2025, leg. Jia-Nan Xu; 1♀ (CN25Nrwx019), same data except 29.vii.2025.

Etymology. The new species is named after Wo-Xing Ren, a major character in the classic wuxia novel *The Smiling, Proud Wanderer,* who is driven by an insatiable ambition and lust for power, striving to dominate the martial arts world, and who particularly enjoys being praised and flattered by others. The name literally means "go anywhere as I wish" in Chinese and also refers to the wide distribution of this species in northwestern Yunnan. Noun in apposition.

Diagnosis. The new species is superficially similar to *N. vittata* Byers, 1999 (Shan State, Myanmar) in the well-developed wing markings, but differs from the latter in the following features: in males, 1) T3 with notal organ digitiform, extending to approximately 7/8 of T4 (*vs.* shorter, reaching nearly 1/2 of T4); 2) gonostyli with earlobe-like basal lobe (*vs.* triangular and rather acute); 3) parameres lobate, greatly divergent in the distal half (*vs.* digitiform, obliquely directed mesad); and in females, 4) medigynium with axis long, and apodemes widely divergent basally (*vs.* axis very short, apodemes indistinct).

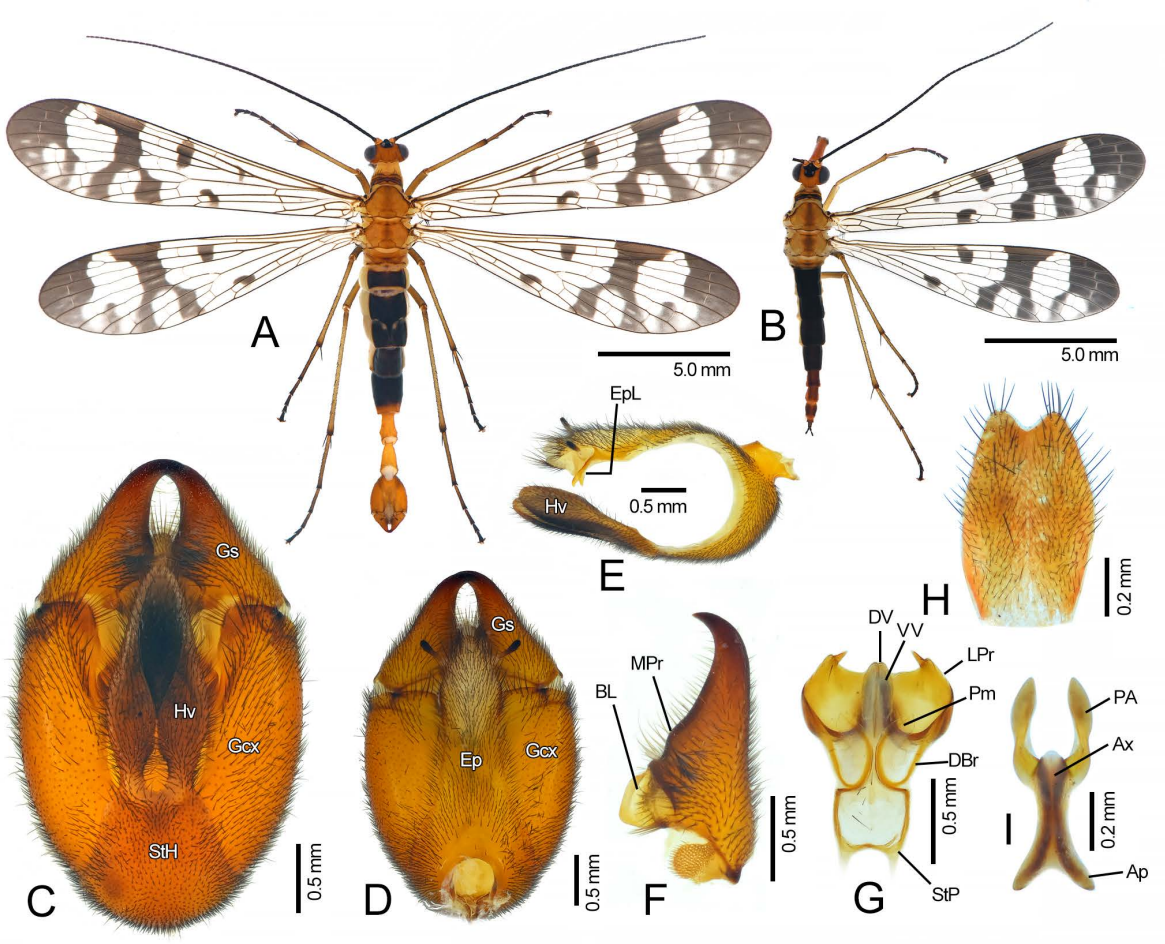

FIGURE 7. *Neopanorpa renwoxing* **sp. nov.**: **A, C–G** male **B, H & I** female **A & B** habitus, dorsal view **C** genital bulb, ventral view **D** genital bulb, dorsal view **E** epandrium and hypandrium, right-lateral view **F** right gonostylus, ventral view **G** aedeagal complex, ventral view **H** subgenital plate, ventral view **I** medigynium, ventral view.

Measurements (mm). *Male* (holotype and paratypes, n = 7): AtL 10.4–10.9, AbL 11.3–12.6, BdL 8.2–9.2, FL 11.6–12.9, FW 3.0–3.1, HL 10.4–11.6, HW 2.9–3.0; *female* (paratypes, n = 12): AtL 10.2–10.7, AbL 10.6–10.8, BdL 6.2–6.7, FL 11.8–12.6, FW 2.8–3.2, HL 10.8–11.8, HW 2.7–3.1.

Description. ***Male.*** *Head* (Fig. 7A). Vertex and occiput yellowish brown; ocellar triangle enclosed by shining black spot, rostrum yellowish; maxillae and labial palps dark brown. Antennae mostly black.

Thorax (Fig. 7A). Pronotum unevenly yellowish brown. Meso- and metanotum mostly yellowish brown, with indistinct dark brown stripe medially. Pleura and legs yellowish brown with apex of tibia and distal tarsomeres black.

Wings (Fig. 7A). Narrow basally with rounded apex. Membrane hyaline with black markings. In forewings, apical band incomplete with open window posteriorly; pterostigmal band complete, with broad basal and apical branches; marginal spot broad; basal band split into two small spots; basal spot absent. Hindwings similar to forewings but more reduced markings.

Abdomen (Fig. 7A). T1–T5 dark brown. T3 with notal organ digitiform, extending to approximately hind border of T4. Membranous region on T4 rectangular. A6 mostly black, apically yellowish brown. A7 and A8 yellowish brown, constricted basally.

Male genitalia (Figs 7C–G). Genital bulb oval, mostly yellowish brown, with only hypovalves dark brown. Epandrium long and broad, unevenly tapering towards apex; epandrial lobes slender, finger-like. Hypandrium with basal stalk broad; hypovalves slightly longer than basal stalk, overlapping mesally and forming subcircular window at constricted base. Gonocoxites broad, with slightly darkened apex; gonostyli bearing obtuse triangular median tooth and earlobe-like basal lobe. Parameres lobate, greatly divergent in distal half; dorsal bridge slender, connected with paramere in wide U-shape basally; stalks of parameres fused basally. Aedeagus conical, with lateral processes very broad basally and sharply pointed terminally.

Female. Similar to males in general appearance, except for denser coloration (Fig. 7B).

Female genitalia (Figs 7H & I). Subgenital plate oval with wide V-shaped terminal emargination (Fig. 7H). Medigynium with main plate undeveloped; axis long, with apodemes widely divergent basally; posterior arms slender, twisted near base, slightly spatulate in distal half, and apically subacute.

Distribution. CHINA: Yunnan: Dali (Yunlong), Diqing (Weixi), Lijiang, and Kunming.

Neopanorpa yucanghai sp. nov. 余沧海新蝎蛉

https://zoobank.org/DF73DE68-341B-4225-B7FC-90165C3F24D7

Figs 8 & 9

Type material. CHINA: Yunnan Province: Holotype ♂ (CN23Nych001), Dali Bai Autonomous Prefecture, Yunlong County, Shuchang Village, 25°51'3.32" N, 99°15'13.55" E, 2540 m, 11.vii.2023, leg. Liang-Jie Jia, Jia-Ling Li, Chun-Mei Liao, Jiao Xie & Ji-Shen Wang; paratypes 7♂2♀ (CN23Nych002–010), same data.

Etymology. The new species is named after Cang-Hai Yu, a minor antagonist in the classic wuxia novel *The Smiling, Proud Wanderer*, who, despite his own limited abilities, covets the martial skills of others and resorts to underhanded methods to obtain them. Noun in apposition.

Diagnosis. The new species closely resembles *N. longistipitata* Wang & Hua, 2018, *N. luojishana* Wang & Hua, 2019, and *N. setigera* Wang & Hua, 2018 in general appearance, especially the greatly reduced wing markings, the long rod-like notal organ on male T3, and the continuous setose regions in T4–T6 as postnotal organs.

It can be readily differentiated from *N. longistipitata* by following characters: 1) abdomen mostly dark reddish brown to black (*vs.* yellowish or light reddish brown); 2) darker nota (*vs.* lighter with narrow mesal stripe); in males, 3) lateral processes of aedeagus short and stout (*vs.* elongated); and in females, 4) medigynium with greatly shortened axis (*vs.* slightly elongated).

It can be differentiated from *N. luojishana* by the following characters: 1) abdomen mostly dark reddish brown

to black (*vs.* mostly yellowish brown); in males, 2) epandrial lobes greatly developed (*vs.* much less developed); 3) gonostyli simple (*vs.* elongated and bearing a tuft of long stout setae on middle of ventral surface); and in females; 4) medigynium with axis greatly shortened (*vs.* greatly elongated and longer than posterior arms).

From *N. setigera* it differs in: in males, 1) lacking long stout setae on middle of gonostyli (*vs.* present); 2) undeveloped dorsal processes in aedeagus (*vs.* developed); and in females, 3) greatly shortened axis in medigynium (*vs.* elongated and approximately as long as posterior arms).

Measurements (mm). *Male* (holotype and paratypes, n = 8): AtL 10.1–10.4, AbL 13.6–14.1, BdL 9.1–10.6, FL 11.2–12.8, FW 2.6–3.0, HL 10.6–11.9, HW 2.5–2.9; *Female* (paratypes, n = 2): AtL 11.3–11.9, AbL 12.9–13.0, BdL 8.6–8.9, FL 13.6–14.0, FW 3.0–3.1, HL 12.4–13.1, HW 2.9–3.0.

Description. *Male.* *Head* (Fig. 9A). Vertex and frons mostly black, with yellowish brown only near compound eyes; rostrum yellowish brown, with two dark brown longitudinal stripes; maxillae and labial palps dark brown. Antennae blackish.

Thorax (Fig. 9A). Pronotum black. Meso- and metanotum black anteriorly and mesally, bearing two small yellowish brown spots near wing bases. Pleura and legs pale brown with apex of tibia and distal tarsomeres black.

Wings (Fig. 9A). Wing membrane hyaline with indistinct markings. Pterostigma reddish brown and distinct. R_2 bifurcated.

Abdomen (Figs 9A & C). T1–T5 black. T3 with notal organ stick-like, bearing dense microsetae along ventral surface, reaching distal end of T5. T4–T6 each bearing line of setae as postnotal organs. A6 reddish brown to black, slightly longer than A5, tapering toward apex, and emarginate in U-shape at dorsal apex. A7 and A8 dark reddish brown, greatly constricted and stalk-shaped basally.

FIGURE 8. Living male of *Neopanorpa yucanghai* **sp. nov.**

Male genitalia (Figs 9D–H). Genital bulb long elliptical, mostly dark brown. Epandrium long and broad, with truncated apex; epandrial lobes developed, subrectangular. Hypandrium with basal stalk broad, and approximately as long as hypovalves; hypovalves slender, extending beyond basal lobe of gonostyli, and slightly convergent apically; hypandrial processes subtriangular. Gonostyli dark brown basally, yellowish brown apically, shorter than gonocoxites, with median tooth indistinctly raised, basal lobe blunt and strongly concave. Paramere slender basally and leaf-shaped distally; basal stalk fused into subrectangular basal frame, and slightly curved outward medially. Dorsal bridge sclerotized, curved and connected to base of lateral processes. Lateral processes short and stout, tapering toward apex; dorsal process indistinct. Ventral valves of aedeagus large, blade-like, tapering toward pointed apexes; dorsal valves slender and truncate, slightly divergent distally.

Female. Similar to males in general appearance except for more developed and denser wing markings, especially, apical and pterostigmal bands (Fig. 9B).

Female genitalia (Figs 9I & J). Subgenital plate elliptical, yellowish brown, with deep V-shaped emargination (Fig. 9I). Medigynium with axis greatly shortened and apodemes stout; posterior arms slender, twisted subbasally, slightly spatulate in distal half, and subacute apically.

Distribution. CHINA: Yunnan: Dali (Yunlong).

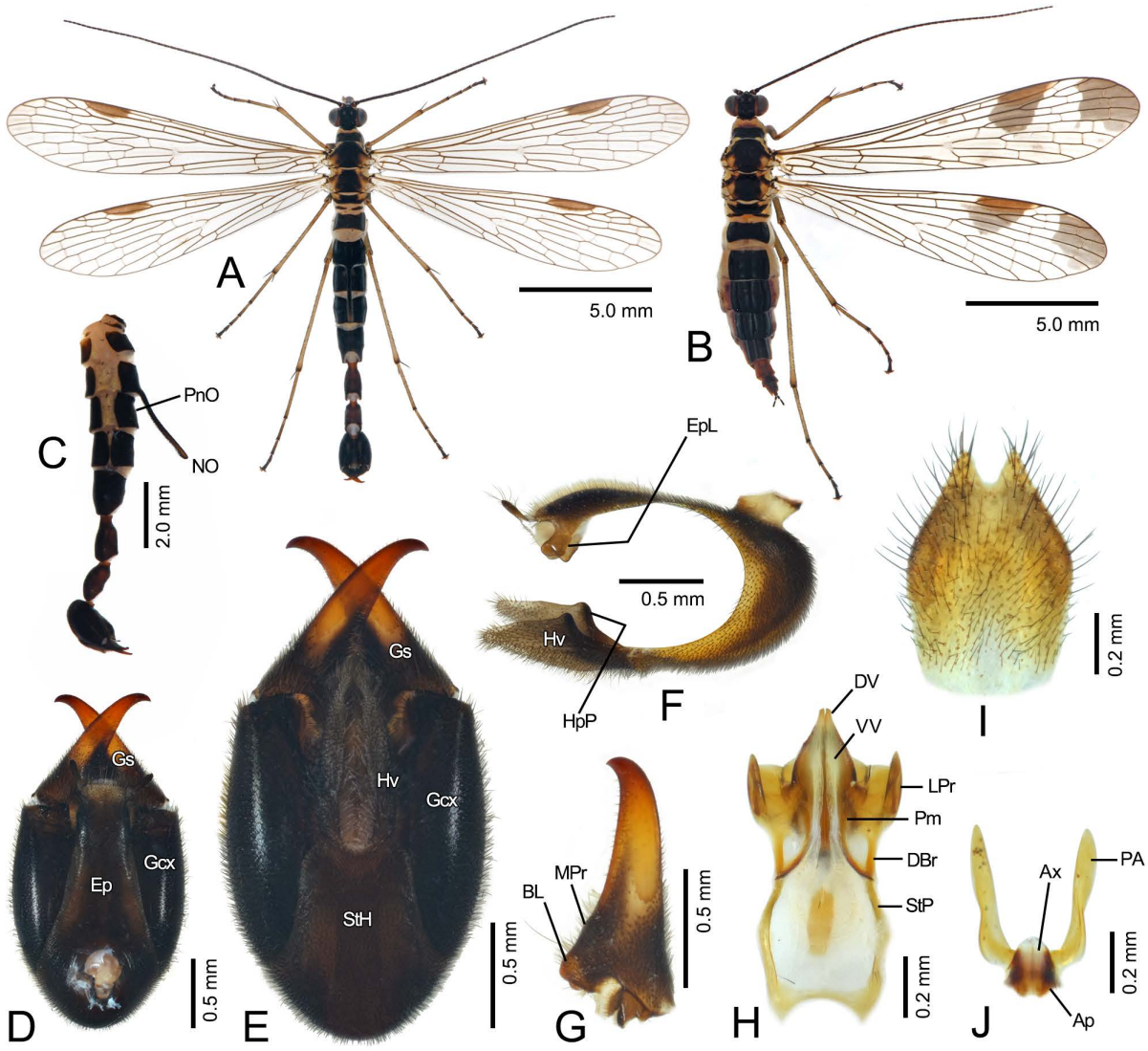

FIGURE 9. *Neopanorpa yucanghai* **sp. nov.**: **A, C–H** male **B, I & J** female **A & B** habitus, dorsal view **C** abdomen, left-lateral view **D** genital bulb, dorsal view **E** genital bulb, ventral view **F** epandrium and hypandrium, right-lateral view **G** right gonostylus, ventral view **H** aedeagal complex, ventral view **I** subgenital plate, ventral view **J** medigynium, ventral view.

Discussion

Before our discovery of *Megapanorpa* in Guizhou and Yunnan Provinces, China, we had noticed that the six previously described species of this genus showed a distinct distribution pattern. Except for *M. anfracta* (Ju & Zhou, 2003), which occurs in Zhejiang Province, eastern China, the remaining species are mainly distributed around the Sichuan Basin, including Chongqing, Gansu, Shaanxi, Hubei, and Sichuan. Based on this semicircular pattern, we hypothesized that some members of this genus can also be found from the southern border of the Sichuan Basin, such as the Wumeng Mountains and the Yunnan-Guizhou Plateau. This hypothesis was supported by our new records of *Megapanorpa* from Guizhou and Yunnan Provinces. Therefore, we further speculate that the mountainous regions surrounding the Sichuan Basin may represent migration corridors and diversification center for species of *Megapanorpa*.

Within *Megapanorpa*, *M. jiangorum* is currently the most widespread species, recorded from western Sichuan, northeastern Yunnan, and Guizhou. The coexistence of *M. jiangorum* and *M. yuebuqun* **sp. nov.** in both Yunnan and Guizhou raises a question commonly encountered in Panorpidae: have closely related species within the same genus evolved to occupy different ecological niches in order to avoid excessive competition and ensure their survival? During our field observations, we collected one male *M. yuebuqun* **sp. nov.** and two female *M. jiangorum* individuals from the same locality (Xiaocaoba) at the same time. All of them appeared to be active among herbaceous ground cover, and no evidence of niche divergence has yet been detected.

The genus *Neopanorpa* can be classified into at least eight species groups (Wang & Hua 2020, 2022). However, the species group-level placement of *N. linghuchong* **sp. nov.** remains unclear. Although *N. linghuchong* **sp. nov.** bears a relatively short notal organ (not extending beyond T4), its genitalia somewhat resemble those of *N. choui* Cheng, 1949 (the *N. choui* group *sensu* Wang & Hua 2021), which possesses an extremely elongated notal organ (extending beyond A7). Specifically, the male parameres are closely aligned in both species, differing from those of most members of the Chinese *N. pielina* and *N. cavaleriei* groups, which are usually divergent. Recent morphological analyses (Wang & Hua 2020) suggest that *N. choui* forms a distinct group together with *N. moganshanensis* Zhou & Wu, 1993. However, molecular analyses (Miao *et al.* 2019) indicate that *N. moganshanensis* belongs to the *N. pielina* group. These findings suggest that certain morphological characteristics—such as the extremely elongated notal organ and the aligned parameres—might have undergone convergent evolution in *Neopanorpa*, reflecting the complex evolutionary relationships among different lineages. Therefore, we refrain from proposing a definitive group-level placement for *N. linghuchong* **sp. nov.** until further evidence becomes available.

According to morphological similarities, *N. renwoxing* **sp. nov.** can be assigned to the *N. pielina* group, especially due to the membranous region on the anterior portion of male T4 (Fig. 7A) and the elongated apodemes in female medigynium (Fig. 7I). Although it resembles *N. vittata* Byers, 1999 (*N. cavaleriei* group) in the greatly developed wing markings, the genital structures are largely different. Its wing markings are also similar to those of the more distantly related members of Panorpidae, such as the *Panorpa communis* group (North and Northeast Asia, and Europe) and the *P. deceptor* group (South China and Japan). Such similarity further suggests that wing markings alone can sometimes represent convergent evolutionary traits, and therefore cannot be used by themselves to determine the group- or genus-level assignment of a species.

Within the *N. pielina* group, several species possess a greatly elongated, rod-like notal organ, which functions in coercive mating by clasping the female's wings (Soszyńska-Maj *et al.* 2022). These include *N. longistipitata* Wang & Hua, 2018 (northwestern Yunnan), *N. luojishana* Wang & Hua, 2019 (southwestern Sichuan), *N. setigera* Wang & Hua, 2018 (southwestern Sichuan), and *N. yucanghai* **sp. nov.** (northwestern Yunnan). These species are also morphologically similar in having greatly reduced wing markings, T4–T6 each bearing a line of numerous setae serving as postnotal organs, narrowed hypovalves, and strongly constricted base of A7 and A8 in males. It is reasonable to speculate that they diversified along the Hengduan Mountains as a result of geographic isolation during the north-south migration of a common ancestor throughout glacial and interglacial periods. Moreover, the

membranous area on male T4 is less prominent (Fig. 9A) than in other members of the *N. pielina* group, suggesting that these species may form a distinct evolutionary lineage and could even warrant recognition as a separate species group.

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Additional information

Author contributions: Conceptualization: J-S Wang & J Xie. Project administration: J-S Wang. Resources: J-S Wang. Supervision: J-S Wang. Visualization: J-S Wang. Writing–original draft: J Xie. Writing–review and editing: J Xie & J-S Wang.

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